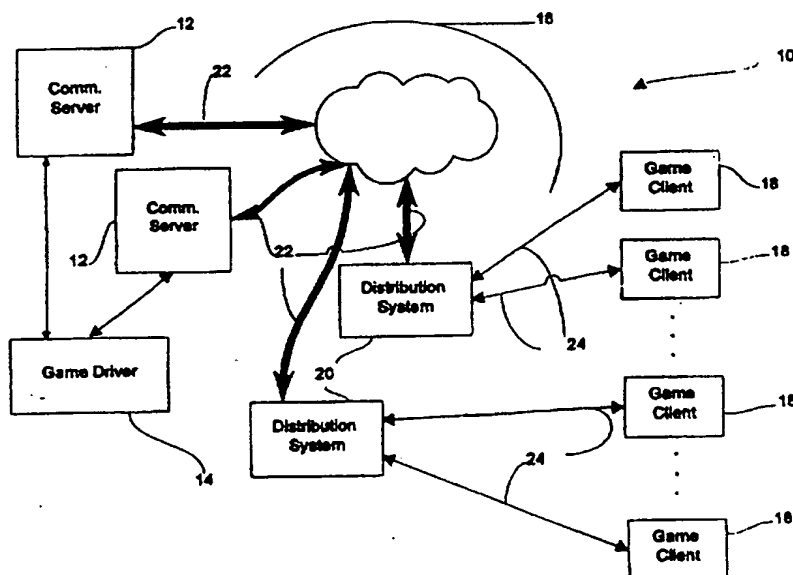




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : H04L 29/06, A63F 9/22		A1	(11) International Publication Number: WO 97/43846
			(43) International Publication Date: 20 November 1997 (20.11.97)
(21) International Application Number: PCT/CA97/00325			
(22) International Filing Date: 15 May 1997 (15.05.97)			
(30) Priority Data: 60/017,768 15 May 1996 (15.05.96) US			
(71) Applicant (for all designated States except US): VR-1, INC. [US/US]; Suite 101, 4888 Pearl Street East Circle, Boulder, CO 80301 (US).			
(72) Inventors; and (75) Inventors/Applicants (for US only): VANGE, Mark [CA/CA]; 18 Chiswell Crescent, North York, Ontario M2N 6E1 (CA). EFFIMOV, Alexander [RU/RU]; Gemsoft Corporation, Suite 500, 12 Sheppard Street, Toronto, Ontario M5H 3A1 (CA). KOUTS, Michael [CA/CA]; Apartment 211, 100 Graydon Hall Drive, Willowdale, Ontario M3A 3A7 (CA). LAGUTIN, Vladimir [RU/RU]; Gemsoft Corporation, Suite 500, 12 Sheppard Street, Toronto, Ontario M5H 3A1 (CA). McKELLER, David [CA/CA]; 7 Ways Lane, Toronto, Ontario M6J 2E8 (CA). PLUMB, Marc [CA/CA]; 43 Farnham Avenue, Toronto, Ontario M4V 1H6 (CA). SHIELDS, Daniel [CA/CA]; Apartment 2, 58 Stafford Road, Toronto, Ontario M6J 2R8 (CA). WILSON, Glenn [CA/CA]; Apartment 204, 137 Roncesvalles, Toronto, Ontario M6R 2L2 (CA).			
		(74) Agents: IMAI, Jeffrey, T. et al.; Gowling, Strathy & Henderson, Suite 4900, Commerce Court West, Toronto, Ontario M5L 1J3 (CA).	
		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).	
		<p>Published</p> <p><i>With international search report.</i></p> <p><i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>	

(54) Title: MULTI-PLAYER GAME SYSTEM AND METHOD



(57) Abstract

An interactive multi-player computer hosted game employs an unstructured telecommunications link, such as the Internet (16), between a game server (14) and a plurality of game clients (18). A game server (14), associated with a game driver (14), performs a performance monitoring function to determine an optimal bandwidth for each connection to a game client. Each information packet generated by the game driver is prioritized and queued for transmission in order of relevance for the game client. The game server then optimizes the transmission of information packets through the telecommunication network to the game client. Processed user input is received through the telecommunication network from the game client and transmitted to the game driver.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakhstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

- 1 -

MULTI-PLAYER GAME SYSTEM AND METHOD

Field Of The Invention

The present invention relates to a system and method of providing an interactive
5 computer-hosted game to multiple players via a communications system.

Background Of The Invention

Computer-hosted games are popular and comprise a wide variety of game subject
matter ranging from conventional games such as chess to more exotic games such as flight
10 combat simulators. Traditionally, in most of these games the player competed against the
computer, which emulated an opponent, or against another player present at the location of
the computer, or a combination of both.

More recently, some computer-hosted games have provided features whereby two or
15 more players can play the game, either cooperatively or competitively, via modem-based,
local area network based, or Internet based telecommunications links between each player's
computer.

While such multi-player games have enjoyed considerable success, they are relatively
20 limited in the number of players which can participate, often allowing no more than a
maximum of four players, and require structured telecommunications links between the
player's computers in order to function properly. Specifically, either a dial up telephone link
or a local area network link must be established between the player's computers so that
minimal latency and guaranteed deliverability of information through the telecommunications
25 link is provided.

Particular examples of Internet-based games include Multi-User Dungeons (MUDs),
AIR WARRIOR, Warbirds, Subspace, and Meridian 59. MUDs are text based
games where multiple users interact, but only in small groups. Players are grouped
30 according to the room in which the player is at any time. Only those players in the same
room will interact with each other. However, since the game is text based, latency of

- 2 -

transmission of information is not a problem for a smooth operation of the game. Further, there is usually a limit on the number of players who may enter a room at any time.

In AIR WARRIOR, Warbirds, Subspace and Meridian 59, there appears
5 to be no apparent limit on the number of players who may play the game at any given time, nor a means of assessing band width requirements and throughput. While the air space of the game may be logically divided, there is no control over the bandwidth of transmission. All information is transmitted on the assumption that all information will arrive at the intended destination in time. Clearly, the assumption becomes less viable as the number of
10 payers and their level of interaction increases.

Summary Of The Invention

It is an object of the present invention to provide a novel multi-player game system and method which obviates or mitigates at least one of the disadvantages of the prior art.
15

It is desirable to have a multi-player game system and method which will support a relatively larger number of players and which does not require structured telecommunications links such as dial up telephone links or local area network links.

20 According to one aspect of the present invention, there is provided a game server for a multi-player game system. The game server comprises:

a game driver for executing a multi-player game and generating game information for playing the multi-player game by at least one game client through a telecommunication network,

25 prioritizing means for prioritizing the game information and responsively queuing the game information for transmission to the at least one game client,

aperture control means for optimizing the game information for transmission to the at least one game client, and

communications means for transmitting the game information through the
30 telecommunication network to the at least one game client and for receiving processed user

- 3 -

input through the telecommunication network from the at least one game client and transmitting the processed user input to the game driver.

According to another aspect of the present invention there is provided method of
5 operating a multi-player game system having a game server communicating with a plurality of game clients connected through a telecommunications network. The method comprises the steps of, for each game client:

- prioritizing game information generated by a game driver executing a multi-player game,
- 10 queuing the game information in order of priority for transmission to the game client,
- optimizing transmission of the game information to the game client,
- transmitting the game information through the telecommunication network to the game client,
- receiving processed user input through the telecommunication network from the game
- 15 client and transmitting the processed user input to the game driver, and
- repeating the steps for playing the multi-player game.

According to another aspect of the invention, there is provided an article of manufacture comprising:

- 20 a computer usable medium having computer readable program code means embodied therein for implementing a multi-player game playable by at least one game client connected through a telecommunications network. The computer readable program code means in the article of manufacture comprises:
 - computer readable program code means for causing the computer to prioritize game
 - 25 information generated by a game driver executing a multi-player game,
 - computer readable program code means for causing the computer to queue the game information in an order of priority for transmission to the at least on game client,
 - computer readable program code means for causing the computer to optimize transmission of the game information to the at least game client,
 - 30 computer readable program code means for causing the computer to transmit the game information through the telecommunication network to the at least one game client,

- 4 -

computer readable program code means for causing the computer to receive processed user input through the telecommunication network from the game client and to transmit the processed user input to the game driver.

5 Brief Description Of The Drawings

Preferred embodiments of the present invention will now be described, by way of example only, with reference to the attached figures, wherein:

Figure 1 shows a schematic representation of an Internet-based embodiment of the present invention;

10 Figure 2 shows a block diagram of a game client for the embodiment of Figure 1;

Figure 3 shows a block diagram of a server and game driver for the embodiment of Figure 1; and

Figure 4 shows a block diagram of performance monitoring, aperture control and synchronization functions of the game server shown in Figure 3.

15

Detailed Description Of The Invention

A multi-player game system in accordance with the present invention is indicated generally at 10 in Figure 1. Game system 10 includes a game driver 14 connected to one or more communications servers 12. Communications server 12 is connected to a
20 telecommunication network 16 which is in turn connected to a plurality of game clients 18 via a distribution system 20.

In the embodiment shown in Figure 1, it is contemplated that telecommunication network 16 will be a data packet type network, such as an IP based network. Thus, network
25 16 will generally comprise a variety of relatively high bandwidth point to point telecommunications links 22, the actual number and identity of the links 22 being subject to change, on a packet to packet basis, depending upon packet routing. The dynamic arrangement of these telecommunications links 22 is indicated in Figure 1 by the cloud-shaped block.

30

- 5 -

While it is contemplated that, in particular, game system 10 can advantageously employ the Internet as telecommunication network 16, it will be apparent to those of skill in the art that the present invention is not limited to such use. Accordingly, other suitable telecommunication networks, including networks which are not packet-based, as will occur
5 to those of skill in the art, can be employed with the present invention as desired.

Distribution system 20 connects game clients 18 to telecommunication network 16 via telecommunications links 24. In the case wherein telecommunication network 16 is the Internet, it is contemplated that distribution system 20 will be an Internet Service Provider
10 (ISP) or the like and telecommunications links 24 will be dial up telephone links, preferably with data communication rates of at least 9600 baud and higher, with higher rates being preferred. It is also apparent to those skilled in the art that distribution system 20 is not limited to a single ISP; multiple ISP's can connect other game clients 18 via separate telecommunications links 24.

15

As will be apparent to those of skill in the art, any other data transmission technique, such as CATV networks, ISDN or distributed fiber optic networks can be used for telecommunications link 24. In any case, it will be understood by those of skill in the art that telecommunications links 24 will be connected to game clients 18 by a suitable data interface
20 for transmitting and receiving data.

Each game client 18 can be any computer platform suitable for executing a game and maintaining a telecommunication link and such platforms include IBM PC compatible computer systems, Apple Macintosh computer systems, games computer systems such as a
25 SEGA Saturn games computer, game consoles or set top consoles.

As shown in Figure 2, each game client 18 can comprise an operating system 100, a communications software 102, an optional client system clock 104 or other means of system synchronization, game client software 106 and a game client API 108 providing a
30 defined interface between communications software 102 and game client software 106. In

- 6 -

addition, game client 18 includes game playing input and output devices 110 to interact with the game player.

Operating system 100 can be any suitable operating system which provides at least
5 a set of basic input and output functions for the hardware platform. If an IBM PC compatible system is selected, operating system 100 can be a GUI-based operating system such as Windows 95 or OS/2 Warp, or an older operating system such as MS-DOS. If an Apple Macintosh is selected, operating system 100 can be Apple's System 7, etc. If a games computer system is selected, such as a SEGA Saturn, Nintendo Ultra or the like, operating
10 system 100 may be rudimentary and/or specifically written to provide necessary system level functions for use as a component of the software of game client 18.

Communications software 102 cooperates with operating system 100 and the communications hardware, such as a modem, LAN or WAN, of game client 18 to establish,
15 maintain and utilize telecommunication link 24 to distribution system 20. Communications software 102 operates to receive information from communications server 12, via telecommunication network 16 and telecommunications link 24 and to forward this received information to client software 106 via client API 108. Communications software 102 also operates to receive information from client software 106, via client API 108, and to transmit
20 this processed data to communications server 12 via telecommunications link 24 and network 16. As will be apparent to those of skill in the art, the transmission of data to game client 18 need not occur at the same rate as data is transmitted from game client 18.

In any event, communications software 102 performs all of the functions necessary
25 to effect the receipt and transmission of data between communications server 12 and game client 18, including performing the necessary steps to construct suitable packets for transmission and/or decode received packets for use by client software 106, including establishing transmission and receipt buffers or analogous means to buffer information, performing error correction on received packets, providing acknowledgement of packets
30 received and/or re-sending packets, re-ordering packets, etc. A variety of known methods

- 7 -

for implementing communications software 102 will be apparent to those of skill in the art and thus will not be further discussed herein.

Client software 106 is executed by game client 18 to, at a minimum, receive input and
5 provide the output necessary for a computer-hosted game to be played at game client 18. Depending upon the hardware capabilities of game client 18, client software 106 can produce a variety of suitable outputs with game playing input and outputs 110 including graphics, text, sounds, etc. Similarly, client software 106 can accept a variety of game player inputs via game playing inputs and outputs 110 including keyboard, joystick, games controller,
10 mouse input, etc.

Client software 106 performs a significant amount of processing of user input received from the game player via game playing input and output 110 and appropriate updating of output. In this manner, raw or processed user input is transmitted back to the
15 game driver 14, limiting the amount of data to be transmitted.

For example, in a flight simulator air combat-type game, client software 106, executing on an IBM PC compatible computer system, can process input received from the game player and produce appropriately updated graphics, status changes, sounds, etc.
20 Specifically, client software 106 will process a user input representing an attitude change for the simulated aircraft through a mathematical model of the flight characteristics of the aircraft to determine the changes to the aircraft's resulting flight condition. The graphics displayed to the game player by game playing input/output 110 is then updated to reflect the appropriate changes to the aircraft's cockpit instruments and the view through the canopy.
25 Further, game client software 106 can determine whether another player's shots have hit, and if so, determine whether the player can continue play. Accordingly, client software 106 preferably performs a significant portion of the processing required to implement a computer hosted game.

30 It is contemplated that client software 106 will be written or modified specifically for each game intended to be played with system 10 and to provide multi-player capabilities

- 8 -

through network 16 via client API 108. Further, while in some cases client software 106 may be stored in a non-volatile memory in game client 18, it is contemplated that in many circumstances client software 106 will be transmitted to game client 18, as needed, via network 16.

5

As shown in Figure 3, communications server 12 may include one or more game servers 200, a server system clock 202, and a server API 204 through which game server 200 communicates with game driver 14.

10 Game driver 14 includes game software 206 providing the co-ordination and arbitration of events resulting from the play of the game players in a particular multi-player game. Game driver 14 may receive information from game clients 18 to which it is connected via communications server 12. The information is processed by game software 206 to produce an appropriate output which is then transmitted to each affected game client
15 18. For example, in an interactive air combat type game, game driver 14 may receive information that a player has fired a shot. After processing by game software 206, the output may be that the player has shot down another player at a different game client 18. Game driver 14 may also transmit information of a global nature to each game client 18, such as a transition from day to night occurring in the game.

20

Game driver 14 may be integrated with communications server 12. However, it is contemplated that game driver 14 be separate software of the multi-player game system 10. An advantage of separating the communications server 12 from the game driver 14 is that a variety of different games can be played by using different game drivers simultaneously
25 with a single communications server 12. Additionally, one or more game drivers 14, responsible for a single game, may communicate with multiple communications servers 12 to communicate with a greater number of game clients 18. However, it is apparent to those skilled in the art that when multiple communications servers 12 are used, the multiple communications servers 12 must be synchronized. Synchronization can be through a network
30 time protocol, or independent means associated with the system.

- 9 -

Game information, in the form of information packets, is forwarded from game driver 14 through server API 204 to game server 200, for transmission to game clients 18. Associated with each information packet is a component referred to by the present inventors as a Relevancy Vector (RV). The RV is a logical construct which provides an indication of the importance of the information in the information packet relative to other packets intended for the same game client 18. In the preferred embodiment, RV's are multidimensional arrays of values that can be examined by game server 200 to evaluate packets against each other to prioritize the packets for transmission. The information packets with the highest RV values are inserted into a queue for transmission to each game client 18 in decreasing order. When information packets are received by the game server 200 which have the same level of importance, the RV is then processed by the game software 206 to arbitrate which is to be transmitted first. The creator of the game software 206 must consider the relative importance of information when creating the game software to provide appropriate rules for arbitrating relative importance of information.

15

For example, in an air combat simulator game, game driver 204 is continually transmitting some information to each game client 18. This information can be: Location(x, y, z); Heading(x, y, z); Global_Status(Hit, Crashed, Exploding); Local_Status(Firing, Weapons, Burning, Control_Surface_Movement); etc. An RV for this information packet will include information for each piece of data which is appropriate to characterize it's relevance. The actual values in the RV array can be booleans, numerical values, flags or mixture of these types, as may be appropriate for the type of information they are associated with. When information packets have the same integer for the first value, *i.e.* the same level of importance, the rest of the RV is then processed by the game software 206 to arbitrate which information packet is to be transmitted first.

For example, the RV can contain the following information:

Location: How far away is the sending aircraft from the receiving aircraft? Is the sending aircraft in the field of view of the receiving pilot?

30 Heading: Is the sending aircraft heading towards or away from the receiving aircraft? If towards, how quickly are they closing?

- 10 -

Global_Status: If any defined event is occurring, is it important?; and

Local_Status: How important is an event to a particular client? This could, for example, depend upon physical distance for visual effects or the age of the information.

5 One of the contemplated advantages of the present invention is that telecommunications network 16 can be the Internet or other network. However, such networks have problems in that the bandwidth available for transmission of a packet from communications server 12 to a game client 18 can change from packet to packet and certainly each time a new telecommunications link 24 is established. Further, depending upon the type
10 of packet protocol employed, it is not always possible to certify delivery of a packet and/or the delivery order of a series of packets. For example, the packet protocol employed on the Internet is presently IP which provides for TCP packets and UDP packets. The delivery and delivery order are guaranteed for a TCP packet. In contrast, delivery and/or delivery order of UDP packets is not guaranteed.

15

While it is desirable to always employ TCP packets or the like, these typically result in a reduced overall useful throughput in telecommunication network 16 due to the protocol overhead and the bandwidth used to transmit the acknowledgement packets which are sent by the destination to confirm receipt of the packet. Therefore, in the embodiment of the
20 present invention shown in Figure 1, UDP packets are employed to maximize the useful throughput of telecommunication network 16. Accordingly, client software 106 and game software 206 are constructed with the assumption that telecommunication network 16 is "lossy", i.e. - some packets may not arrive at their intended destination, as is described below in more detail.

25

To achieve satisfactory performance regardless of the lossy nature of the transmission network, game server 200 performs a performance monitoring function 300 and a bandwidth aperture function 320, each of which is discussed below with reference to Figure 4.

30

In the performance monitoring function 300, the game server 200 attempts to monitor the available bandwidth of the connection between game server 200 and each respective game

- 11 -

client 18. Specifically, at step 302, game server 200 'floods' a connection to a respective game client by transmitting packets at an initial bandwidth predetermined by the capabilities of the transmission network, and varying the transmission speed up or down depending on the capabilities of the connection to a specific game client 18. In a manner somewhat similar to the PING utility of the IP protocol, information relating to the transmission time of these packets is reflected back to game server 200 and recorded. Alternatively, information relating to the transmission time of packets can be assessed on an ongoing basis without flooding the connection.

10 The information reflected back to performance monitoring function 300 at server 200 includes the total round trip transmission time. However unlike the PING utility, the packets are of a variety of sizes, rather than a fixed size, to more closely replicate the real world transmission of game data packets which are of variable length. The performance monitoring function 300 increase or decreases the transmission rate and records the transmission time for each packet sent back to game server 200.

From the data produced in the above-described latency test, at step 304 the performance monitoring feature develops a set of metrics for each connection, including the bandwidth available and, more importantly, how the latency in the connection varies with bandwidth utilization and packet size. These metrics are used in conjunction with the aperture control function 320. The communications bandwidth is maximized to an optimal bandwidth until the predetermined maximum latency is exceeded.

In general, the optimal bandwidth is determined by determining a maximum bandwidth at the predetermined maximum latency. If the maximum bandwidth is greater than the initial bandwidth, the initial bandwidth is increased to the maximum bandwidth. If the maximum bandwidth is less than the initial bandwidth, the initial bandwidth is incrementally reduced to the maximum bandwidth. The process is continuously repeated varying the optimal bandwidth. If the maximum bandwidth is outside predetermined limits at any time, the connection is terminated.

- 12 -

The predetermined maximum latency is set by the author of the game. Certain games can withstand greater latency than others. For instance, chess can have an extended latency whereas air combat games must have a very short latency.

5 It will be understood by those of skill in the art that performance monitoring function 300 will be performed each time a connection is established to a game client 18 and is assessed on an ongoing basis. Game server 200 continuously monitors each transmission of each information packet and will determine whether the latency is increasing or decreasing. In response, the bandwidth is varied so that the predetermined maximum latency is not
10 exceeded.

As will be apparent to those of skill in the art, transmission latency is an important consideration in implementing a multi-player computer hosted game and, specifically, interactions between players which are subject to large latencies are often unacceptable. For
15 example, an unacceptable latency can result in one player in an air combat simulator shooting at another player who avoids the shot because he has moved to another location before the data representing the shot arrives at his game client 18 from game server 200. Accordingly, the present inventors have determined that game server 200 must give consideration to the metrics for both the available bandwidth and the latency characteristics for each connection
20 and these metrics are used to derive a present optimal bandwidth for the connection at step 306. As used herein, the term present optimal bandwidth refers to the bandwidth at which the best transmission bandwidth is obtained for a preselected maximum latency.

As will be apparent to those of skill in the art, each of the game clients 18 may
25 experience a different latency with the consequence that different game clients 18 will transmit and receive information at different rates. This is further complicated by the fact that the latency for each game client changes every time a new Internet connection is made. Moreover, each of the client system clocks 104 and game system clock 202 may be set to different times. Therefore, further associated with each information packet is a time stamp.

- 13 -

Communications server 12 time stamps the information packet when it is inserted in the queue and sets an age limit on each information packet. In order that the time stamp associated with each information packet is consistent for each game client 18, the time stamp attached to each information packet is synchronized with the game client's client system clock 5 104 by synchronization function 350. Each time game client 18 makes a new connection, a client time signal according to the client system clock 104 is sent to the game driver 14 where the signal is received at a certain system time as indicated by the game system clock 202 at step 352. Game driver 14 calculates the difference between the system time and client time at step 354.

10

When an information packet is being assembled for a specific game client 18, the difference calculated at step 354 is subtracted from the system time to arrive at the synchronized time stamp in step 356.

15 As mentioned above, game server 200 implements an aperture control function 320. Aperture control function 320 is used to proactively restrict and optimize the bandwidth of the data leaving communications server 200 to the present optimal bandwidth for the connection. Specifically, at step 322, game server 200 examines each information packet received from game driver 14 to determine its bandwidth requirements.

20

At step 324, game driver 14 examines the RV associated with each information packet and determines the relevance of each information packet relative to those others intended for the same game client 18. The information packets with the highest relevancy are inserted into a queue in decreasing order.

25

At step 326, if the time the information packet sits in the queue exceeds its age limit, then the information packet is discarded or deleted. Otherwise, the information packets remain in the queue and could be assembled into larger data packet(s) which will not exceed the present optimal bandwidth at step 328. Game server 200 assembles the information 30 packets into one or more data packets and transmits the data packets to game client 18 at step 330.

- 14 -

In the example RV given above, if an information packet relates to an aircraft which is firing its weapons, but which is out of range of the aircraft flown by the player at a game client 18, then aperture control function 320 will queue this information packet if the present optimal bandwidth to game client 18 would be exceeded. If the aircraft is flying and there
5 are several other aircraft flying, some nearer than others, then the information packets relating to the nearest aircraft are transmitted first and more frequently to the game client 18.

The above-described embodiments of the invention are intended to be examples of the
10 present invention and alterations and modifications may be effected thereto, by those of skill in the art, without departing from the scope of the invention.

- 15 -

We claim:

1. A game server for a multi-player game system, said game server comprising:
a game driver for executing a multi-player game and generating game information for playing said multi-player game by at least one game client through a telecommunication
5 network,
prioritizing means for prioritizing said game information and responsively queuing said game information for transmission to said at least one game client,
aperture control means for optimizing said game information for transmission to said
at least one game client, and
10 communications means for transmitting said game information through said telecommunication network to said at least one game client and for receiving processed user input through said telecommunication network from said at least one game client and transmitting said processed user input to said game driver.
- 15 2. A game server as claimed in claim 1 wherein said aperture control means comprises monitoring means for determining an optimal bandwidth of a connection through said telecommunications network to said at least one game client; and
limit means for limiting a bandwidth for transmission of said game information to said optimal bandwidth.
- 20 3. A game server as claimed in claim 2 wherein said monitoring means comprises means for flooding said connection with information to determine a latency characteristic of said connection;
means for developing a set of metrics for said connection responsive to said latency
25 characteristic; and
means for assessing said set of metrics and responsively determining said optimal bandwidth.
4. A game server as claimed in claim 3 wherein said game information is generated in
30 information packets, and said prioritizing means assesses each information packet, produces an array of values indicative of a relevance relative to other information packets for said at

- 16 -

least one game client and assess the array for queuing each information packet in order of highest relevance first.

5. A game server as claimed in claim 4 wherein said game server has
5 means for receiving a time signal from said at least one game client when said at least one game client connects with said game server through said network and determining a difference between a game server time and time of said at least one game client, and synchronization means for applying said difference to each information packet.

10 6. A game server as claimed in claim 5 wherein said prioritizing means has means for setting an age limit for each information packet to remain in said queue, and
means for discarding each information packet from the queue if said age limit is exceeded.

15

7. A game server as claimed in claim 6 wherein said game server has a plurality of game drivers.

8. A game server as claimed in claim 6 wherein said game driver generates game
20 information for playing said multi-player game by at least two game clients through a telecommunication network, and said prioritizing means prioritizes said game information and responsively queues said game information for each of said at least two game clients, and said aperture control means optimizes said game information for transmission for each of said at least two game clients.

25

9. A method of operating a multi-player game system having a game server communicating with a plurality of game clients connected through a telecommunications network comprising the steps of, for each game client:

prioritizing game information generated by a game driver executing a multi-player
30 game,

- 17 -

queuing said game information in order of priority for transmission to the game client,

optimizing transmission of said game information to the game client,

transmitting said game information through said telecommunication network to the
5 game client,

receiving processed user input through said telecommunication network from the game client and transmitting said processed user input to said game driver, and

repeating the steps for playing the multi-player game.

10 10. A method as claimed in claim 9 wherein said step of optimizing comprises the steps of

determining an optimal bandwidth of a connection through said telecommunications network to said game client; and

limiting a bandwidth for transmission of said game information to said optimal
15 bandwidth.

11. A method as claimed in claim 10 wherein said step of determining an optimal bandwidth comprises the steps of:

flooding said connection with information at an initial bandwidth to determine a
20 latency characteristic of said connection;

developing a set of metrics for said connection responsive to said latency characteristic; and

assessing said set of metrics and responsively determining a maximum bandwidth at a preselected maximum latency, and if the initial bandwidth is less than the maximum
25 bandwidth, increasing the initial bandwidth to said maximum bandwidth, and if said initial bandwidth is greater than said maximum bandwidth incrementally reducing the initial bandwidth to said maximum bandwidth and if the maximum bandwidth is outside predetermined limits, terminating the connection.

- 18 -

12. A method as claimed in claim 11 wherein said step of determining an optimal bandwidth is repeated each time a new game client is connected to the game server through the telecommunications network.
- 5 13. A method as claimed in claim 12 wherein said game information is generated in information packets, and said step of prioritizing comprises the steps of assessing each information packet for its relevance relative to other information packets for said game client, and queuing each information packet in order of highest relevance first.
- 10 14. A method as claimed in claim 13 wherein said method further includes the steps of receiving a time signal from the game client when said game client connects with said game server through said network;
determining a difference between a game server time and time of said game client,
and
15 applying said difference to each information packet.
15. A method as claimed in claim 14 wherein said step of claim 14 is conducted on an ongoing basis.
- 20 16. A method as claimed in claim 14 wherein said step of prioritizing includes the steps of
of
setting an age limit for each information packet to remain in said queue, and
discarding each information packet from the queue if said age limit is exceeded.
- 25 17. An article of manufacture comprising:
a computer usable medium having computer readable program code means embodied therein for implementing a multi-player game playable by at least one game client connected through a telecommunications network, the computer readable program code means in said article of manufacture comprising:
30 computer readable program code means for causing the computer to prioritize game information generated by a game driver executing a multi-player game,

- 19 -

computer readable program code means for causing the computer to queue said game information in an order of priority for transmission to the at least one game client,

computer readable program code means for causing the computer to optimize transmission of said game information to the at least one game client,

5 computer readable program code means for causing the computer to transmit said game information through said telecommunication network to the at least one game client,

computer readable program code means for causing the computer to receive processed user input through said telecommunication network from the game client and to transmit said processed user input to said game driver.

10

18. The article of manufacture as claimed in claim 17 wherein said computer readable program code means for causing the computer to prioritize game information generated by a game driver executing a multi-player game includes computer readable program code means for assessing information packets of said game information, for producing an array
15 of values indicative of a relevance relative to other information packets for said game client and for assessing the array for queuing each information packet in order of highest relevance first.

19. The article of manufacture as claimed in claim 18 wherein said computer readable
20 program code means to optimize transmission of said game information to the at least one game client, includes

computer readable code means for flooding said connection with information to determine a latency of said connection;

computer readable code means for developing a set of metrics for said connection
25 responsive to said latency; and

computer readable code means for assessing said set of metrics and responsively determining a maximum bandwidth at a preselected maximum latency, and for increasing an initial bandwidth to said maximum bandwidth if the initial bandwidth is less than the maximum bandwidth, and incrementally reducing the initial bandwidth to said maximum
30 bandwidth if said initial bandwidth is greater than said maximum bandwidth and terminating the connection if the maximum bandwidth is outside predetermined limits.

- 20 -

20. The article of manufacture as claimed in claim 19 wherein said computer readable program code means for optimizing transmission of said game information to the at least one game client, further includes

computer readable code means for receiving a time signal from the game client;

5 computer readable code means for determining a difference between a game server time and time of said game client, and

computer readable code means for applying said difference to each information packet.

10 21. The article of manufacture as claimed in claim 20 wherein said computer readable program code means for optimizing transmission of said game information to the at least one game client, further includes

computer readable code means for causing the said computer readable program code means for optimizing transmission of said game information to the at least one game client,
15 to optimize on an ongoing basis.

22. The article of manufacture as claimed in claim 19 wherein said computer readable program code means for causing the computer to prioritize game information generated by a game driver executing a multi-player game further comprises,

20 computer readable code means for setting an age limit for each information packet to remain in said queue, and

computer readable code means for discarding each information packet from the queue if said age limit is exceeded.

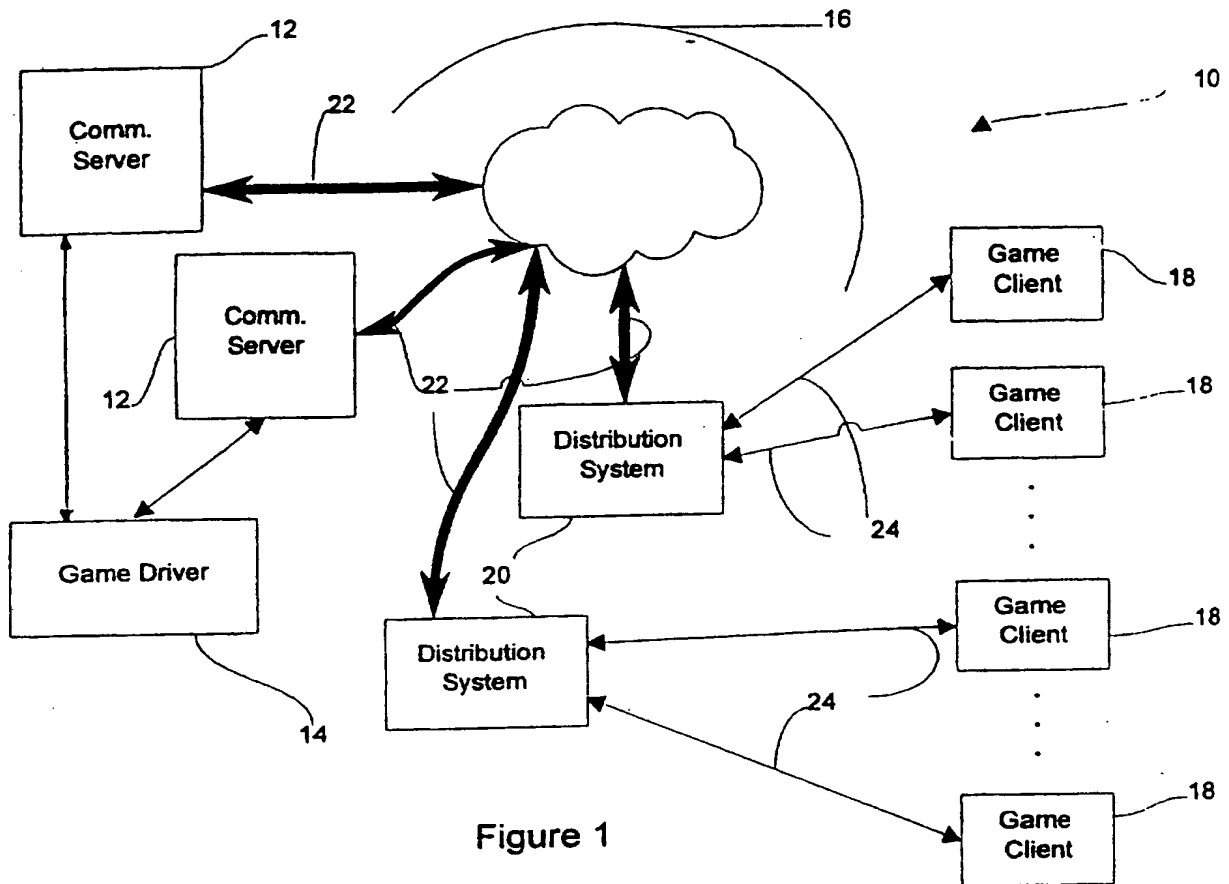


Figure 1

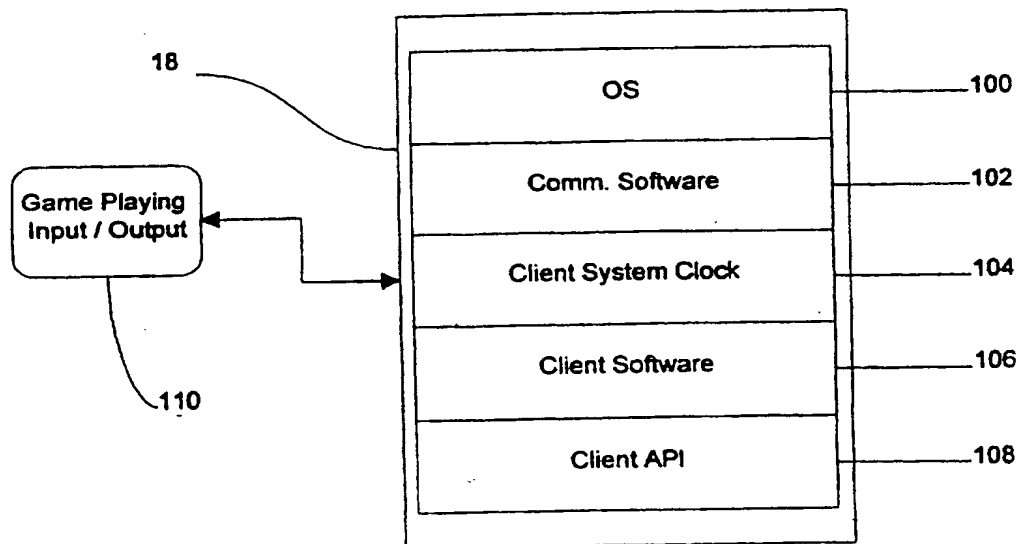


Figure 2

2/3

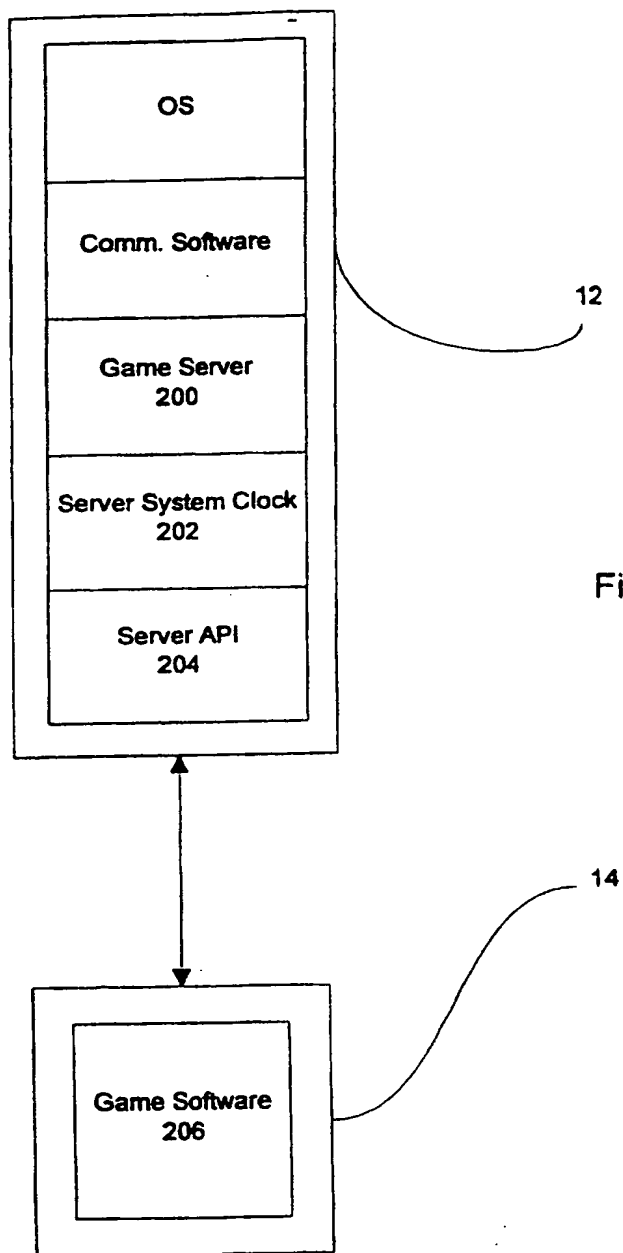


Figure 3

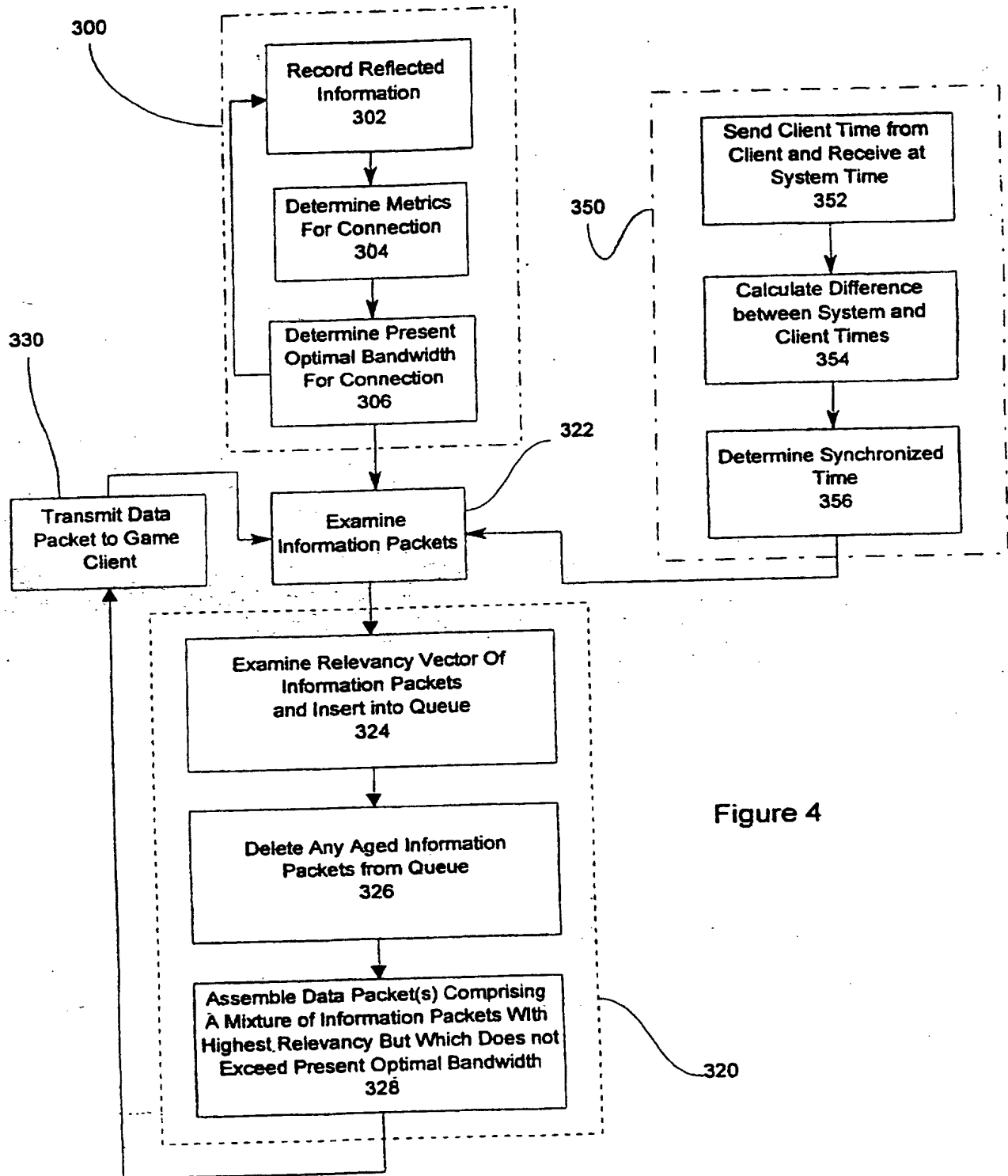


Figure 4

INTERNATIONAL SEARCH REPORT

Inter national Application No
PCT/CA 97/00325

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04L29/06 A63F9/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04L G09B A63F G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 95 08793 A (VIRTUAL UNIVERSE CORP.) 30 March 1995 see page 1, line 1 - page 3, line 3 see page 3, line 36 - page 8, line 37 see page 10, line 2 - page 11, line 19 see figure 1 see figure 5	1
A		9,17
Y	PROCEEDINGS OF THE IEEE, vol. 83, no. 8, August 1995, NEW YORK US, pages 1124-1136, XP000524899 R.C.HOFER ET AL: "DIS TODAY" see paragraph I see paragraph II see paragraph IV	1
A		9,17

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

9 September 1997

Date of mailing of the international search report

18 SEPTEMBER 1997

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax (+31-70) 340-3016

Authorized officer

Canosa Arete, C

INTERNATIONAL SEARCH REPORT

Inter. nal Application No

PCT/CA 97/00325

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>PROCEEDINGS OF THE IEEE, vol. 83, no. 8, August 1995, NEW YORK US, pages 1114-1123, XP000524898 D.C.MILLER ET AL: "SIMNET: THE ADVENT OF SIMULATOR NETWORKING" see paragraph IV see paragraph VI see paragraph X see figures 3,4</p>	1,9,17
A	<p>--- PROCEEDINGS OF THE IEEE, vol. 83, no. 8, August 1995, NEW YORK US, pages 1156-1167, XP000524901 J.MARK PULLEN ET AL: "NETWORKING TECHNOLOGY AND DIS" see paragraph III see paragraph IV see paragraph VII.D</p>	1,9,17
A	<p>--- WO 93 23125 A (CODEMASTERS LTD.) 25 November 1993 see page 2, line 1 - page 4, line 27 see page 7, line 1 - line 14 see page 9, line 1 - line 18 see page 12, line 27 - page 13, line 13 see page 17, line 28 - page 19, line 2 -----</p>	1,9,17

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/CA 97/00325

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9508793 A	30-03-95	US 5659691 A	19-08-97
		AU 7736694 A	10-04-95
		EP 0721614 A	17-07-96
		JP 9503082 T	25-03-97
WO 9323125 A	25-11-93	AU 4080593 A	13-12-93